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## NAVY RADIO METEOROGRAPH SYSTEM

In Technical News Bulletin 239 (March 1937), the development of a radio meteorograph system, for use by the aerological service of the United States Navy Department, was announced. Since that time, the component parts of the system have been materially improved and its performance has been determined through simultaneous radio meteorograph and aerograph soundings of the upper atmosphere under typical service conditions. Fifty early morning radio meteorograph soundings were made in cooperation with the aerological and radio personnel of the Navy Department at the Naval Air Station, Anacostia, D. C. The soundings were timed to occur practically simultaneously with the regular early morning aerograph soundings in a Navy airplane. Gratifying agreement was obtained between the observations with the two types of instruments, the comparisons demonstrating conclusively that the radio meteorograph is ready for routine daily use. While affording the same order of accuracy of measurement as the aerograph, the radio meteorograph can be used during adverse visibility conditions and can attain much higher altitudes (12 to 15 miles) instead of about 4 miles for the usual airplane sounding.

The radio meteorograph attached to a small unmanned balloon, sends down radio signals which give a measure of the variations in atmospheric pressure, air temperature, and air humidity as the balloon ascends. The decrease in barometric pressure as the balloon rises is utilized to operate a small switch arm which moves over a set of electrical insulating and conducting strips. The conducting strips are electrically interconnected with two resistors which control the modulating frequency or pitch of the radio signals. One of these resistors consists of a small capillary

[1] Published with approval of the Director of the Budget.

glass tube filled with an electrolyte which varies markedly in electrical resistance with the surrounding air temperature. The second resistor is mechanically varied by the expansion or contraction of a hair element and hence varies with the relative humidity. The temperature resistor is normally in circuit so that the modulating frequency or pitch is normally proportional to the temperature. At predetermined pressure levels, corresponding to approximately 500-foot increments in the height of the balloon, the switch-arm switches in the humidity resistor and the modulating frequency or pitch becomes a measure of the relative humidity. At the ground receiving station, an automatic graphical frequency recorder connected in the output of a receiving set converts the variations in pitch into a plot of temperature and humidity against pressure.

The improvements incorporated in the system during the past year have increased the stability of the modulating oscillator and the accuracy of frequency measurement at the ground receiving station. The design of the capillary thermometer has been materially improved and its cost reduced. A simplified calibrating and operating procedure has been evolved which increases the accuracy of the observations while at the same time permitting rather wide tolerances in manufacture, in order to reduce cost.

The results of the comparison tests of the radio meteorograph and the aerograph showed an agreement of pressure readings within about 2 millibars (1.5 millimeters of mercury), agreement of the temperature readings within 2° C, and agreement of the humidity readings within 10 percent relative humidity. One unusual comparison test is of interest. On November 9, 1937, a new air mass passed over Anacostia just after the release of the radio meteorograph. The radio meteorograph was carried away with the old air mass, while the airplane sounding was in the new air mass. This was clearly shown by the comparison. Observations obtained by an airplane sounding at Norfolk about 1 hour earlier, showed the same temperature inversion indicated by the radio meteorograph and not shown by the Anacostia aerograph record. A second radio meteorograph, released about 4 hours after the simultaneous test, gave good agreement with the Anacostia aerograph record, indicating that its sounding was now in the new air mass.

## RADIOMETRIC MEASUREMENTS OF ULTRAVIOLET SOLAR INTENSITIES IN THE STRATOSPHERE

In RP1075 by R. Stair and W. W. Coblentz, which will be published in the Journal of Research for February, a description is given of the photoelectric cell and filter type of ultraviolet-intensity meter, which is combined with an audio-frequency generator and radio transmitter, for transportation aloft by means of unmanned balloons. A brief account of flights made during the past summer was given in Technical News Bulletin 247 (November 1937).

In this apparatus, the radio-frequency wave is modulated by the response of the photoelectric cell, the response being proportional to the intensity of the incident ultraviolet rays. The height of the balloons is indicated by a radio barograph. The radio signals giving the altitude of the apparatus and the ultraviolet intensities are received and recorded graphically at a ground station.

Six balloon ascensions were made during the latter part of June and the early part of July 1937. Altitudes up to about 24 km (80,000 ft) were attained, but owing to the weakness of the signal and the consequent interference by noise, strictly quantitative data were obtained only to about 19 km (64,000 ft).

Below 14 km the transmissions of ultraviolet through the filters remain fairly constant, indicating but little change in the spectral quality of the shortest wave lengths. At a height of about 14 km, the transmissions of the filters begin to decrease, indicating a selective increase in intensity of ultraviolet of the shortest wave lengths, as a result of a decrease in the amount of ozone above the apparatus.

Between 14 and 19 km, the filters show an unmistakable decrease in transmission, indicating that the apparatus had passed through an appreciable portion of the ozone layer, variously estimated at 15 to 30 percent of the superposed ozone; the lower value being in good agreement with previous explorations (in 1934), taking into consideration the latitude and the season of the year.

At the highest altitudes attained, the intensity of the ultraviolet radiation in the band of wave lengths shorter than 3132 A was about three times the value observed at sea level. This spectral

band includes, of course, also wave lengths not observed at sea level.

## CODE FOR PROTECTION AGAINST LIGHTNING

The protection of persons and property against lightning is a subject of widespread interest and of considerable importance. Since the time of Benjamin Franklin, the value of lightning rods for safeguarding buildings has been recognized. Early in the art of utilizing electric energy, lightning arresters were employed in connection with exposed overhead lines. In the fields of both buildings and electric equipment there has been a great variety of practice, and many installations have been made which did not adequately fulfill the purpose for which they were intended.

A code establishing standards of practice for lightning protection was included by the American Standards Association in the first list of safety codes on its program. The American Institute of Electrical Engineers and the Bureau were designated as sponsors for this project, the scope of which included the protection of buildings, oil tanks, and other structures; trees, livestock, and persons; and overhead electric lines and apparatus connected to them.

A sectional committee was organized by the sponsors in 1921, and in 1929 it completed the formulation of definite standards for the protection of persons (part 1), buildings and other property (part 2), and structures containing flammable liquids and gases (part 3). These were published in Miscellaneous Publication M92 of the Bureau. In 1932 the sectional committee revised parts 1 and 2 of the code, and in 1937 it made slight revisions in all three parts. The last edition was approved by the American Standards Association, October 29, 1937, and issued by the Bureau as Handbook 21. Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents each.

The subject matter contemplated for this code originally comprised also two parts, dealing with electric apparatus and lines. Practice in these fields had not, however, crystallized to the point where it was felt that definite standards could be set up. The committee consequently issued only a preliminary report on this part of the subject, which was published by the Bureau as Miscellaneous Publication M95.

Part 1 of the code is very brief and gives some simple instructions on what a person should do during a thunderstorm to avoid being struck by lightning. If one cannot avoid remaining out-of-doors, it is well to keep away from isolated trees, from wire fences, from hilltops and wide-open spaces, and from small sheds which are in an exposed location. If no building is available for shelter, a cave, a deep valley, a grove of trees, or dense woods offer some protection.

Part 2 of the code gives specifications for lightning rods to protect buildings, and sets forth the requirements for satisfactory installations. Special sections are devoted to steeples, water towers, chimneys, hangars, buildings containing baled flammable materials, ships, and trees. A section is included on the protection of livestock in fields.

Part 3 deals with the protection of oil tanks and gives fundamental principles to be applied, rather than the detailed construction which is offered in the case of buildings.

These specifications are followed by all of the prominent manufacturers and installers of lightning rods, and compliance with them is necessary to secure the approval of Underwriters' Laboratories, Inc. The work of developing them was done in cooperation with a committee of the National Fire Protection Association, and the standard of this organization makes the same requirements.

The question of how much protection to a building is afforded by lightning rods is often asked. It is admitted that this protection is not perfect if the requirements of the code alone are followed. An elaborate metallic cage about the building would be necessary. However, compliance with the code does give a high degree of protection, as is evidenced by the reports of many State fire marshals on fires caused by lightning. Nearly all cases of loss are for buildings which have not been rodded, and in the few cases of loss of rodded buildings there is a question whether the installation has been kept in good condition. For instance, conductors sometimes corrode at the ground line, thus breaking the connection. The chances of injury to a building which is properly rodded are very small. This does not mean that rodded buildings are not struck by lightning, but that, when struck, the discharge is carried harmlessly to ground. Since losses by fire from lightning have been greatly reduced by the installation of lightning

rods, these are especially recommended for isolated farm buildings, where the likelihood of damage is much greater than in a city.

In spite of the value of lightning rods, their use has at times and in some places come into disrepute owing to a general lack of information on the best methods of protection. It is hoped that the publication of definite standards will enable the public to demand installations which will give them adequate protection.

Further experience and the accumulating knowledge about lightning may lead later to changes in these specifications, and revisions will be made from time to time as experience and progress in the art may warrant. Comments on these specifications and recommended changes are invited by the committee from all who have had experience in applying them.

## SUPERCONDUCTORS AT RADIO FREQUENCIES

At the exceedingly low temperature (−269° C or −452° F) at which helium gas becomes a liquid, certain metals show the very remarkable property of losing all their electrical resistance. This phenomenon is known as superconduction.

The equipment for producing and measuring low temperatures at the Bureau, developed for its work of calibrating low-temperature thermometers, permits of experiments in this range. RP1070 by F. B. Silsbee, F. G. Brickwedde, and R. B. Scott, which will be published in the February number of the Journal of Research, describes experiments which show that superconduction occurs at the same temperature and to the same extent with currents of radio frequency as with direct current. Special experiments also indicate that the mysterious mechanism which thus conducts electricity with 100-percent efficiency can be alternately brought into action and then paralyzed again within 5 millionths of a second by suitable magnetic impulses.

## INFRARED ABSORPTION OF HYDROCARBONS

In connection with the work of the American Petroleum Institute Research Project 6, on the separation and identification of hydrocarbons from petroleum, the property of infrared absorption between 1.2 and 1.8$\mu$ (5,400 to 8,900 cm$^{-1}$) was originally used to "fingerprint" the hydrocarbons isolated. Hydrocarbons of low molecular weight, most of which have been synthesized and subjected to measurement, can be identified by comparison with the synthetic preparations, using such physical properties as molecular weight, carbon-hydrogen content, boiling point, freezing point, density, and refractive index, and leaving the infrared absorption spectra as a corroborating "fingerprint." However, relatively few of the hydrocarbons of high molecular weight have been synthesized and it often becomes impossible to identify the hydrocarbons isolated from petroleum because of the absence of data on the corresponding synthetic hydrocarbons of known structure.

It has been known for several years that the infrared absorption due to C—H vibrations in the region of the spectrum from 1.2 to 1.8$\mu$ (5,400 to 8,900 cm$^{-1}$) is different both in wave length and intensity for the characteristic structural groups $-CH_3$, $>CH_2$, $\rightarrow CH$, and $>CH$ (aromatic). It seemed desirable, therefore, to ascertain if this property might not yield quantitative, as well as qualitative, information concerning the structural units of an unknown molecule. Data from previous studies in this region on the infrared absorption spectra of 54 hydrocarbons were, therefore, analyzed mathematically, and the results are reported in a paper (RP1072) by F. W. Rose, Jr., which will be published in the February number of the Journal of Research.

The total molal absorption index, $K$, at any given wave number, is shown to follow, within the limits necessary to define the number of groups, the equation

$$K = n_a\alpha + n_b\beta \qquad \text{(a)}$$

for the normal paraffin hydrocarbons, and the equation

$$K = n_a\alpha' + n_b\beta + n_c\gamma + n_d\delta \qquad \text{(b)}$$

for other classes of hydrocarbons, where $n_a$, $n_b$, $n_c$, and $n_d$ are the number of $-CH_3$, $>CH_2$, $\rightarrow CH$, and $>CH$ (aromatic groups) and $\alpha$ (or $\alpha'$), $\beta$, $\gamma$, and $\delta$ are the values, respectively, of the absorptive index for a unit group. The equation becomes simpler at certain wave numbers where one or two of the groups show substantially zero absorption. Equation b is demonstrated to hold for branched-chain paraffins, cycloparaffins (naphthenes) and aromatic hydrocarbons, including 10 of high molecular weight ($C_{24}$ to $C_{32}$). The accuracy of the method, and restrictions on its application, are discussed, and

possible extensions in order to distinguish between paraffins and cycloparaffins are indicated. The use of the method is demonstrated by an example of the identification of an unknown isomeric nonane from petroleum.

## SPECTRUM OF LUTECIUM MONOXIDE

Atoms are characterized by line spectra, but so-called band spectra are always associated with chemical compounds. Band spectra ascribed to monoxides of a large number of the elements are known, but, up to the present, the emission spectrum of only one rare-earth (gadolinium) monoxide has been reported. This was observed in the oxyhydrogen flame and was said to vanish at arc temperature. Most of the monoxide compounds, which have revealed spectra, are chemically unstable, and instability at arc temperature may account for the general lack of data on the spectra of rare-earth oxides. Among the 14 rare earths, the heaviest, lutecium, is unique in showing a sequence of intense blue bands in the conventional arc spectrum. This sequence and two parallel sequences of faint bands form a band system characteristic of lutecium monoxide molecules, as shown by a vibrational analysis conducted by William W. Watson and William F. Meggers, and reported in the Journal of Research for February (RP1071).

## BROMINE OXIDATION AND MUTAROTATION MEASUREMENTS WITH *α-d-β-* MANNOHEPTOSE AND *α-d-α-* GULOHEPTOSE

A paper (RP1069) by Horace S. Isbell, which will be published in the Journal of Research for February, describes the making of the lead salts of *d*-α-mannoheptonic acid and *d*-β-mannoheptonic acid, and their use for the separation of the corresponding free acids. The gamma lactone of *d*-β-mannoheptonic acid was prepared and reduced with sodium amalgam to give *d*-β-mannoheptose which was separated in the crystalline alpha modification. This new sugar is structurally related to *α-d*-talose and exhibits similar properties. Its mutarotation is complex, consisting in a fast change followed or accompanied by a smaller slow change. The proportions of the constituents involved in the rapid reaction vary with temperature, so that a change in temperature results in a change in the proportions of these constituents which gives rise to a rapid mutarotation. The temperature coefficient for the rapid mutarotation reaction of *d*-β-mannoheptose corresponds to that for the rapid mutarotation reactions of galactose, arabinose, talose, ribose, and d-β-glucoheptose, while the temperature coefficient for the slow change agrees with the temperature coefficients for the mutarotations of glucose, mannose, gulose, and other reactions which consist in the interconversion of the alpha and beta pyranoses. The paralellism between the properties of *d*-talose, *d*-α-guloheptose, and *d*-β-mannoheptose is evidence that the configurations of the five carbon atoms comprising the pyranose ring determine in large measure the composition of the equilibrium solutions of the sugar. Measurements of the rates of oxidation with bromine water show that *α-d-β* mannoheptose and *α-d-α* guloheptose are oxidized at rates comparable to that previously found for the oxidation of *α-d*-talose, and that the equilibrium solutions contain substantial quantities of rapidly oxidizable material.

## SOLUBILITY OF GLASS AND GLASS ELECTRODE DEPARTURES

Applying the method for determining the solubility of optical glasses, described in Technical News Bulletin 221 (September 1935), to a glass which is commonly used for making glass electrodes, the following results were obtained by E. H. Hamilton, Donald Hubbard, and A. N. Finn:

1. The solubility increases rapidly for most alkaline solutions as the pH increases above 8.5 or 9.

2. There is a slight decrease in solubility as the pH changes from 8.5 to 2, but between these concentrations the solubility is much less than for alkalinities above pH 8.5.

3. The solubility decreases rapidly in the acid range beyond pH 2.

Considering these statements in connection with the performance of glass electrodes, these regions of marked solubility change (pH 8.5 and 2) correspond exactly to the two regions of pronounced voltage departures exhibited by electrodes made from this glass.

That the voltage anomalies of the glass electrode are definitely associated with the solubility of the glass has been further demonstrated by the use of glasses which do not have the marked solubility change in the "super acid" region, and by measurements made in alkaline solutions in which soluble silicates are not formed, such as aqueous

solutions of ammonia. Under these conditions the voltage departures are very slight.

## LIST OF PUBLICATIONS ON COLORIMETRY AND SPECTROPHOTOMETRY

A revised edition of Letter Circular LC398, the list of publications on colorimetry and spectrophotometry, has just been issued. In addition to many new publications not contained in the previous edition, a complete subject index is now included, which greatly simplifies the location of papers on any given topic. A sufficient number of cross references are given to make this task an easy one. Copies of this list can be obtained without charge by anyone who has a real need for it, by addressing the Colorimetry and Spectrophotometry Section, National Bureau of Standards, Washington, D. C. Requests should explain the use to which the list will be put.

## USE OF STANDARD DYEINGS IN TESTS FOR COLORFASTNESS TO LIGHT

A paper by W. D. Appel, chief of the Bureau's textile section, which will be published soon in the American Dyestuff Reporter, deals with the testing and rating of textiles with respect to colorfastness to light. It has a particular significance at this time, as a result of the recent action of the research committee of the American Association of Textile Chemists and Colorists, which has adopted standard dyeings of known fastness and is undertaking to make them available to all laboratories. These dyeings will enable the laboratories, for the first time, to express fastness on a common basis.

The standards are four in number and represent the minimum requirements for fastness classes 1, 3, 5, and 8 (in increasing order of fastness). The same standards have been adopted by the British and the German fastness committees and may be regarded as international. The selection of the intermediate standards, 2, 4, 6, and 7, which are needed principally for classifying dyestuffs, is being held in abeyance, pending further discussion by the committees abroad.

Why such standards are necessary, and how they can be used to the best advantage, are discussed in the paper.

The ideal test for colorfastness to light would require apparatus with which the fading resulting from exposure in service could be duplicated in a short time (say 24 hours), and instrumental means for measuring the fading. The first condition is approximated in available apparatus, but the amount of fading produced by exposure for a given number of hours, both in the same and in different fading lamps, varies greatly from time to time. The cost of the equipment to eliminate this variation is prohibitive. Fortunately, the relative fading of dyeings in these lamps is reproducible. By testing simultaneously the fastness of the materials in question and of standard dyeings of known fastness issued to all laboratories by a central source, it will be possible for all to arrive at the same ratings of fastness.

Quantitative methods for evaluating the changes in color of dyeings when they fade, are not available in most textile laboratories and they are too slow for routine testing, though they may be used to advantage when visual judgment is uncertain. The changes in color of the standard dyeings furnish a guide when the method of visual inspection is used. Most fading can be judged rapidly and satisfactorily in this way.

## CREASE-RESISTANT FINISHES FOR FABRICS

With the advent of crease-resistant finishes in the commercial production of cloths, it has become increasingly important to measure the improvement of the cloths resulting from the finishing teatment and also the resilience of fabrics in general. In the Journal of Research for February (RP1077), Herbert F. Schiefer reports on work undertaken to determine the flexural characteristics of representative woven fabrics before and after the application of commercial crease-resistant finishes, using three different methods: (1) Creasing angle; (2) flexometer; and (3) modified compressometer. Specimens of paper, Cellophane, cotton, rayon, worsted, and rubber, which are recognized to vary in resistance to creasing over a considerable range, were also measured and the results used for comparison.

The crease-resistant finishing treatments increased the energy required to deform the cloth specimens, that is, increased the stiffness of the cloths. This increase exceeded 100 percent for some of the cloths. The energy of recovery was also increased by these treatments,

the increase ranging from 20 to 100 percent. Neither of these two quantities can be taken individually as a measure of crease resistance. However, the ratio of the latter to the former is related to the resistance to creasing. The resilience of nearly all of the cloths, as determined by each of the three test methods, was increased by the crease-resistant finishing treatments.

The three test methods described can be used to evaluate the improvement given by crease-resistant finishes, using the measurements on the cloths before treatment as the basis of comparison. They should be valuable in systematic studies of the effect of different finishing treatments and in determining the effects of relative humidity, temperature, and other factors on the different finishes. Method 1, however, does not give a critical measure of stiffness, a property that is greatly affected by crease-resistant finishes and should be measured. The resilience as determined by these methods is dependent upon the testing conditions, as for example, the magnitude of the maximum load in method 3. It may be found necessary, in test methods of this type, to vary the maximum load with the thickness or weight of the fabric to be tested.

## WEATHERING TESTS ON FILLED COATING ASPHALTS

Asphalt shingles and roll roofings are made by impregnating felt with a relatively soft asphalt and then surfacing with a harder asphalt, known as a coating asphalt. In recent years, it has become general practice to mix finely ground slate, limestone, and similar mineral fillers, with the asphalt coatings. However, as data were lacking to show the serviceability of filled coatings, an investigation was undertaken by O. G. Strieter, research associate at the National Bureau of Standards, representing the Asphalt Shingle and Roofing Institute, to determine the effect of various kinds and grades of commercial fillers on the weather-resisting properties of coating asphalt. A variety of asphalt-filler mixtures was prepared and their weather-resisting properties were determined by exposing them outdoors in various localities, and to the accelerated weathering test.

These weathering tests, outdoor and accelerated, are described in detail in RP1073, in the Journal of Research for February. The tests showed that suitable fillers greatly increase the life of an asphalt, although all the fillers tested did not prove equally effective.

## FIRE TESTS OF TREATED AND UNTREATED WOOD PARTITIONS

Fire-protection engineers now use a standard fire-testing procedure to determine how well a wall, partition, or door, will resist destruction and heat transmission when subjected to fire. Recently, Clement R. Brown of the Bureau's fire resistance section, conducted some fire tests on thirteen 4-foot-square partitions and four larger partitions built of wood. Some of the small partitions were built of untreated wood, but most of them were constructed of wood treated with fire-retarding chemicals. The panels differed in thickness, design, and amount of treatment. The results of these tests are given in RP1076, which will be published in the Journal of Research for February. It was found that, as measured by these tests, the resistance to penetration of fire and heat through the partition was affected little by treatment, but appreciably by thickness and design. The principal value of treatment was to reduce the amount of flaming during and, more particularly, after the fire test.

As compared with fire-tube and flame-penetration tests on small specimens representative of each panel, the results show that only the flame-penetration test is related to the standard fire test, and in this case, only to a limited extent.

## MINOR CONSTITUENTS IN PORTLAND CEMENT CLINKER

The composition of the less abundant substances (phases) in portland cement clinker is of importance because it affects, considerably, the heat of hardening and durability of the finished cement products. A paper (RP1074) by Herbert Insley and Harold F. McMurdie, which will be published in the February Journal of Research, records the identification of some of the minor phases by microscopic methods using transmitted and reflected light. A new type of preparation is described, which permits the examination of the same field by both reflected and transmitted light. Improvements in identification of free CaO and free MgO are described, and the presence of $4CaO.Al_2O_3.Fe_2O_3$ in most cement clinkers is confirmed. Although $3CaO.Al_2O_3$ is found in small amounts in some clinker specimens, it is a comparatively rare constituent. Glass is

present in most clinkers and a prismatic interstitial material, which apparently is a crystalline compound of alkalies with other constituents, is frequently found.

The relations of the interstitial materials are a function of composition, rate of cooling, and uniformity of the batch mixture. The impossibility of determining equilibrium relations, cooling rates, and other factors in the manufacture of commercial clinker, make it impossible at present to determine, quantitatively, the phases.

## WATER PENETRABILITY OF CLAY AND SHALE BUILDING BRICK

Upper and lower limits for water absorption were included in the early specifications for building bricks. Since the methods of test for water absorption involve the total immersion of the test specimen for a relatively long period (usually 5 hours or more), this test is a measure of the absorptive capacity of the brick. Other tests have been devised which measure the rapidity with which water is absorbed, among such tests being the determination of gain in weight of the brick resulting from partial immersion in water for 1 or 3 minutes, and the measurement of the time required for the complete absorption of 1 ml of water spread over 5 sq cm of the brick surface. Since these short-time tests measure the ease of penetration of water into brick, they are called penetrability tests.

The penetrability of bricks has been shown to have a great effect on the strength and quality of bond between brick and mortar. Specifications have been written which set upper and lower limits on penetrability. Obviously, the utility of such a specification will depend in part upon the possibility of securing commercial supplies of brick which conform to it. A study of this subject has been made at the Bureau and a paper entitled Penetrability of Clay and Shale Building Brick, by J. W. McBurney and A. R. Eberle, has been submitted for publication in the Journal of the American Ceramic Society. Results are presented from tests of approximately 1,600 bricks, which were a random selection from a sample of 3,886 bricks, representing the product of about 250 plants in the United States. The effect on penetrability of raw material (clay or shale), method of forming (dry press, soft mud, or stiff mud), and geographical location, was studied. Comparisons of results of tests by several methods are included. The principal conclusions are:

1. The relation between gain in weight by 1- and 3-minute partial immersion in water is linear for bricks which do not wet through in 3 minutes under the conditions of this test.

2. The average gain in weight by 1-minute partial immersion is 58 percent of the average gain in weight by 3-minute partial immersion according to these data.

3. Considering all raw materials and methods of forming, the relation between the average gain in weight by partial immersion in water for 3 minutes and average water absorption (total immersion at room temperature for 5 hours, or 48 hours, or by boiling for 5 hours) is fairly regular up to 44 grams (approximately 1.5 ounces) gain in weight by partial immersion for 3 minutes. The relation becomes increasingly erratic as the gain in weight by 3-minute partial immersion increases.

4. Fifty-eight percent of the shale bricks had gains in weight by 3-minute partial immersion of less than 1 ounce; the corresponding figure for the clay bricks was 36 percent. The range 1 to 4 ounces included 36 percent of the shale bricks and 55 percent of the clay bricks.

5. Bricks formed by the dry-press process have notably greater penetrabilities than those formed by the soft-mud, stiff-mud side-cut, or stiff-mud end-cut processes.

6. In only 12 of 23 districts did 50 percent or more of the specimens fall within the limits of 1 to 4 ounces gain in weight by partial immersion in water for 3 minutes. Three districts (Hudson Valley, Philadelphia, and Chicago) provided specimens of which more than 75 percent fell within this limit.

## PORE SIZE AND WATER PERMEABILITY OF BRICKS

In a study of pore structure of structural clay products under investigation by R. T. Stull and P. V. Johnson, the water permeabilities of 46 different building bricks have been determined. These bricks represent specimens made by the stiff-mud and dry-press processes and were selected from five different brands. They represent specimens from "soft" to "hard-burned" with a range in porosity from 12.25 to 39.80 percent, and a range in mean pore radius from 0.95 to 4.49 microns.

The volume of water per unit of flow pressure passing through some of the

bricks decreased with respect to time, while for others the flow increased. Bartell[2] (quoting Schmidt and Quincke) observed a decrease in water permeability with respect to time, and attributed the decrease in flow to partial clogging of pores by mechanically loosened particles. However, no mention seems to have been made of instances where the flow increased with respect to time.

| Brand | Kind of brick | Number of specimens | Range in pore radius | Change in flow |
|---|---|---|---|---|
| | | | *Microns* | |
| *F*---- | Hard-burned stiff-mud. | 8 | 0.95–1.98 | Increase. |
| *G*---- | Soft-burned stiff-mud. | 10 | 1.33–1.90 | Do. |
| *H*---- | Hard-burned stiff-mud. | 8 | 2.66–3.50 | Decrease. |
| *J*---- | Hard-burned dry-press. | 10 | 3.88–4.49 | Do. |
| *K*---- | Soft-burned dry-press. | 10 | 3.00–3.52 | Do. |

In the table it is seen that flow increased for the bricks of *F* and *G* and decreased for those of *H*, *J*, and *K*. No definite correlation appears between the nature of the flow and "hardness of the burn" or between flow and process of manufacture (stiff-mud or dry-press process), a definite correlation between the nature of the flow and the average pore radius.

The average pore radii of the specimens of *F* and *G* (showing increasing flow) ranged from 0.95 to 1.98 microns, whereas in the specimens of *H*, *J*, and *K* (showing decreasing flow) the average pore radii ranged from 2.66 to 4.49 microns. The dividing line between increasing and decreasing flow for the kind of bricks tested therefore appears to be located somewhere between average pore radii of 1.98 and 2.66 microns.

The assumption that the change in the time-flow of water through bricks results from the partial clogging of the pores by loosened particles does not seem to be justified.

## DOLOMITIC HYDRATED LIMES

The attention of the Bureau has been directed to the fact that certain portions of Research Paper RP1022, an abstract of which was published in Technical News Bulletin 244 (August 1937), have been construed by some as prejudicial to dolomitic limes. This construction was not intended. The objects of this paper were to present a new method of determining the degree of hydration of magnesia in dolomitic hydrated limes and putties, and to study the rates of hydration under various conditions. Since this new method makes possible the determination of the content of free magnesia, the Bureau proposes to carry out an investigation to determine the amount of any late hydration of hardened mortars and plasters.

[2] F. E. Bartell. *The permeability of porcelain and copper ferrocyanide membrances.* J. Phys. Chem. 15, 665 (1911).

## SIMPLIFIED PRACTICE RECOMMENDATION FOR MACHINE, CARRIAGE, AND LAG BOLTS

Printed copies of Simplified Practice Recommendation R169–37, machine, carriage, and lag bolts (steel)—stock production sizes, are now available and can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

The recommendation, which was proposed and developed by the industry, establishes a simplified schedule of stock production sizes for steel square-head machine bolts, steel hexagon-head machine bolts, steel square-neck carriage bolts, and steel lag bolts.

This schedule of recommended stock production sizes for bolts became effective on November 1, 1937, and is subject to regular review by a standing committee of the industry.

## NEW AND REVISED PUBLICATIONS ISSUED DURING JANUARY 1938

### Journal of Research[3]

Journal of Research of the National Bureau of Standards, volume 20, number 1, January 1938 (RP1059 to RP1068, inclusive). Price 25 cents. Annual subscription, 12 issues, $2.50.

Journal of Research of the National Bureau of Standards, title page, corrections, and contents to volume 18, January to June 1937 (RP957 to RP1005, inclusive). Free on application to the Bureau.

[3] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription in Technical News Bulletin, 50 cents per year; Journal of Research, $2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and the Republic of Panama); other countries, 70 cents and $3.25, respectively.

### Research Papers [3]

[Reprints from October and November 1937 issues of the Journal of Research]

RP1034. Graphical computation of stresses from strain data. Ambrose H. Stang and Martin Greenspan. Price 10 cents.

RP1040. Improved continuously variable self and mutual inductor. Herbert B. Brooks and Arthur B. Lewis. Price 10 cents.

RP1041. Effect of wave form upon the performance of current transformers. John H. Park. Price 5 cents.

RP1042. Service-test results of titanium-treated and silicon-treated steel rails. G. Willard Quick. Price 5 cents.

RP1043. Stress-strain characteristics of wool as related to its chemical constitution. Arnold M. Sookne and Milton Harris. Price 5 cents.

RP1044. Entropy of isoprene from heat-capacity measurements. Norman Bekkedahl and Lawrence A. Wood. Price 5 cents.

RP1045. Recombination in the afterglow of a mercury discharge. Fred L. Mohler. Price 5 cents.

RP1046. Test of floor coverings for post-office workrooms. Warren E. Emley and Carl E. Hofer. Price 10 cents.

RP1047. Evaluation of crush-resistant finishing treatments for fabrics. Herbert F. Schiefer. Price 5 cents.

RP1048. Study of vibrated concrete. John Tucker, Jr., G. L. Pigman, E. A. Pisapia, and J. S. Rogers. Price 10 cents.

RP1049. Study of ball packings for laboratory rectifying columns. Augustus R. Glasgow, Jr., and Sylvester T. Schicktanz. Price 5 cents.

### Simplified Practice Recommendations [3]

R24–37. Hospital beds. (Supersedes R24.) Price 5 cents.

R169–37. Machine, carriage, and lag bolts (steel). (Stock-production sizes.) Price 5 cents.

### Technical News Bulletin [3]

Technical News Bulletin 249, January 1938. Price 5 cents. Annual subscription, 50 cents.

[3] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription in Technical News Bulletin, 50 cents per year; Journal of Research, $2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and the Republic of Panama); other countries, 70 cents and $3.25, respectively.

## MIMEOGRAPHED MATERIAL

### Letter Circulars

Letter circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of letter circulars or to send copies automatically as issued.

LC510. Protective coatings for underground piping systems. (Supersedes LC435.)

LC511. Information on ultraviolet transparency of window materials and fabrics. (Supersedes LC429.)

### Technical Information on Building Materials

The supply of these notes, each of which consists of three or four pages, giving the important facts on some one aspect of the properties or use of building materials, is necessarily limited. Their distribution will be confined to Government officials concerned with building projects and to architects, engineers, and home builders. Requests should make clear the actual need for the information at the time of writing. Letters should be addressed to the Division of Codes and Specifications, National Bureau of Standards, Washington, D. C. The following notes were issued since the January 1938 number of the Technical News Bulletin was printed:

TIBM–59. Durability of some loose-fill and aluminum foil insulating materials.

TIBM–60. Corrosion of materials used in house construction: Indoor corrosion by condensation.

## RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS [4]

Soil-corrosion testing. K. H. Logan, S. P. Ewing, and I. A. Denison. Symposium on Corrosion Testing Procedure (Am. Soc. Testing Materials, 260 South Broad St., Philadelphia, Pa.) 99 (December 1937).

Dental silicate cements: Physical and chemical properties and a specification. G. C. Paffenbarger, Irl C. Schoonover, and Wilmer Souder. J. Am. Dental Assn. (212 East Su-

[4] These publications are not obtainable from the Government unless otherwise stated. Requests should be sent direct to the publishers.

perior St., Chicago, Ill.) 25, 32 (January 1938).

Heats of formation of simple organic molecules. Frederick D. Rossini. Ind. Eng. Chem. (Mills Bldg., Washington, D. C.) 29, 1424 (December 1937).

A portable photoelectric timer. Francis C. Morey. Instruments (1117 Wolfendale St., Pittsburgh, Pa.) 10, 308 (December 1937).

Tests for mechanical properties of yarns. Herbert F. Schiefer. Textile Research (65 Franklin St., Boston, Mass.) 8, 72 (December 1937).

What can the mill man expect from fundamental research? Milton Harris. Am. Dyestuff Reporter (440 Fourth Ave., New York, N. Y.) 27, No. 1, 6 (January 10, 1938).

The use of standard dyeings in tests for colorfastness to light. W. D. Appel. Am. Dyestuff Reporter 27, No. 1, 15 (January 10, 1938).

Evaluation of crease-resistant finishes for fabrics. Herbert F. Schiefer. Am. Dyestuff Reporter 27, No. 1, 22 (January 10, 1938).

Passage of moisture through packaging materials. Frederick T. Carson. Food Industries (McGraw-Hill Book Co., New York, N. Y.) 10, 14 (January 1938).

Plastics as structural materials for aircraft. G. M. Kline. Technical Note 628 (National Advisory Committee for Aeronautics, Washington, D. C.). (Obtainable free from the Committee.)

U. S. GOVERNMENT PRINTING OFFICE: 1938